

Variants of Personality Maladaptation in Patients with Multiple Sclerosis

T. N. Reznikova, I. Yu. Terent'eva, and G. V. Kataeva

Translated from Zhurnal Nevrologii i Psikhiiatrii imeni S. S. Korsakova, Vol. 106, No. 8, pp. 13–20, August, 2006. Original article submitted April 25, 2005.

A total of 34 patients with multiple sclerosis (MS) aged 14–52 years, with disease onset at age 24.3 ± 7.5 years, were studied. Disease severity on the Kurtzke scale (EDSS) was 3.6 ± 1.7 points. Seven patients were in exacerbation of MS and 27 were in remission. Personality characteristics in terms of MS-associated maladaptation were studied using a modified MMPI (the SMPT method). Neurotic, psychotic, and mixed types of maladaptation were identified. Measures of brain metabolic activity were simultaneously determined (in terms of the rate of glucose utilization) by positron emission tomography (PET). Data were obtained on the relationship between the activity of metabolic processes in the frontal, temporal-parietal, and limbic areas of the cerebral cortex and different variants of personality maladaptation and, respectively, with different personality profiles in the SMPT.

KEY WORDS: personality, maladaptation, brain metabolism, positron emission tomography, multiple sclerosis.

Multiple sclerosis (MS) is a serious CNS disease affecting people of working age; it has a remitting nature and quickly leads to invalidity. According to published data [1, 7], the more severe neurological symptomatology of MS is accompanied by a variety of neuropsychological and personality abnormalities, among which neurosis-like states and affective disorders (depression and euphoria) are of prime importance in the clinical picture and are especially significant for patients. Psychological investigations of personality in patients with MS using observation, interview, descriptive, and other methods have identified personality features such as sthenia, demonstrativity, rigidity, and irritability, and, conversely, increased anxiety, depressivity, apathy, and emotional lability [1]. This is known to reflect different variants of personality maladaptation – neurotic, psychotic (behavioral), and mixed (psychosomatic), i.e., emotional-dynamic patterns based on the type of nervous activity and the properties of temperament forming the individual means of responding to stress situations [18]. Despite the high incidence, heterogeneity, and severity of psychological afflictions in patients with MS, their nature

remains incompletely studied and the symptoms themselves are given essentially no consideration during treatment and rehabilitation.

However, the introduction of positron emission tomography (PET) into diagnostic practice in recent years has led to the publication of further reports demonstrating impairments of metabolic processes in the brains of patients with MS. Several studies [5, 21, 23, 24] have shown that the process of demyelination, which progresses as the disease advances, is accompanied by global and regional decreases in glucose metabolism in the brain.

PET, a method allowing visualization of the functional status of brain structures both in different mental states and during the performance of mental activity, allows the identification of structures which, according to the terminology of Bekhterev [4], constitute the flexible and rigid components of the structural-functional system supporting a variety of mental processes. In the presence of this pathology, it is important to identify the neuropsychological basis of maladaptive personality patterns. Thus, there is great interest in comparing these patterns with the characteristics of the functional state of brain structures using PET.

The aim of the present work was to identify variants of personality maladaptation in patients with MS using the

Institute of the Human Brain, Russian Academy of Sciences, St. Petersburg.

multifactorial Standardized Multifactorial Personality Test (SMPT) method to and compare these variants with the characteristics of metabolic processes in the brain as detected by PET. [Translator's note: The Russian abbreviation for SMPT transliterates into English as SMIL, which can be found in some literature searches.]

MATERIALS AND METHODS

A total of 34 patients with MS – 21 females and 13 males aged 14–52 years – took part in the study. Mean age was 34.6 ± 9.4 years and the mean age of disease onset was 24.3 ± 7.5 years; disease duration was 9.7 ± 8.1 years and mean severity on the Kurtzke scale (EDSS) [26] was 3.6 ± 1.7 points. Seven patients were in exacerbation and 27 were in remission. Remitting disease was present in 21 patients (two of which were progressive-remitting), while 13 had the progressive form (12 secondary progressive and one primary progressive). All patients underwent clinical investigations at the Institute of the Human Brain, Russian Academy of Sciences. Clinical psychological studies were performed, along with PET.

The SMPT standardized multifactorial personality test method was used, this being Sobchik's modification of the MMPI method [17, 18]. Our studies used an integral approach to interpreting the ratios of the characteristic scales of the test with assessment of their contributions to the profile, allowing increases in and combinations of different scales to be used to define variants of personality maladaptation. The neurotic variant of maladaptation was demonstrated by a predominance of hyposthenic properties and showed inhibitory features; these patients were characterized by slow mental processes, emotional inertness, lack of self-realization, conformity, increased self-control, passivity, fixation, and apathy. In the psychotic variant, the emotional-dynamic personality pattern was dominated by sthenic properties, i.e., dominance of excitatory features, manifest as easy transitions from one type of activity to another, over-responsiveness, emotional impulsivity, lack of restraint, and lack of self-criticality. The mixed variant of personality maladaptation reflected a combination of hyposthenic and sthenic properties and was taken as evidence of an extreme degree of maladaptation, in which a high need for self-realization conflicts with a high level of self control and a tendency to repress behavioral reactions, manifesting as the absence of reactions and eliciting emotional over-tensioning of personality [18].

Glucose metabolism was studied using a PC2048-15B positron emission tomograph (a detailed description of the methodology has been presented in [6]). Regional accumulations of radiotracer activity (^{18}F -labeled fluorodeoxyglucose, FDG), normalized to the mean activity accumulated over the whole brain (the global mean), provided a relative assessment of the level of glucose metabolism. Measure-

ments of absolute values of the rate of glucose metabolism (glucose metabolic rate, GMR) expressed in pmoles per 100 g of tissue per minute were not made because of the need for additional measurements of FDG activity in plasma from arterialized venous blood, which significantly complicates the analysis. The limits of the normal range of GMR are quite wide, and in some cases, such as uniform groups of patients, relative assessments are more stable than absolute values [22, 28, 29] and constitute independent diagnostic information [25, 27].

Relative GMR values in the standard areas of interest, reflecting the anatomical-functional structure of the brain, provided data for statistical analysis. Evaluations used the Spearman rank correlation coefficient and the non-parametric Mann-Whitney test.

RESULTS

Patients with MS were divided into subgroups depending on the type of SMPT profile as follows: subgroup I (13 patients) were of the neurotic type (increases on scales 2, 7, and 0); subgroup II (five patients) were of the behavioral psychotic type (increases on scales 4, 6, and 8); subgroup III (seven patients) were of the psychosomatic mixed type (increases on scales 1, 2, 3, 8, and 9); subgroup IV (nine patients) had a harmonic profile within the normal limits (Fig. 1).

The main characteristics of these subgroups are shown in Table 1.

Thus, the patients showed different personality impairments which determined the corresponding types of personality maladaptation. The commonest variant was the neurotic, seen in 38% of cases. Age and disease duration distinguished this subgroup from the subgroup with mixed (psychosomatic) variant of personality maladaptation but were no different from those in the other subgroups. The absence of any difference in age, disease duration, and disease severity between patients with the neurotic and psychotic variants of personality maladaptation and patients with the harmonic SMPT profile shows that the latter subgroup had psychological adaptation mechanisms in disease conditions. It should be noted that patients with the mixed variant of personality maladaptation differed from patients with the neurotic variant by having a longer duration of disease ($p < 0.01$) and greater age ($p < 0.03$) and from patients with SMPT profiles within the normal range by a longer duration of disease ($p < 0.02$). This led us to conduct an analysis of the SMPT profile characteristics in relation to the duration of disease. This divided the patients into four subgroups (Table 2).

The group with disease durations of 1–5 years had higher ($p < 0.05$) measures on SMPT scales 1, 3, and 8 as compared with those with a disease duration of less than one year, where the SMPT profile was within the normal

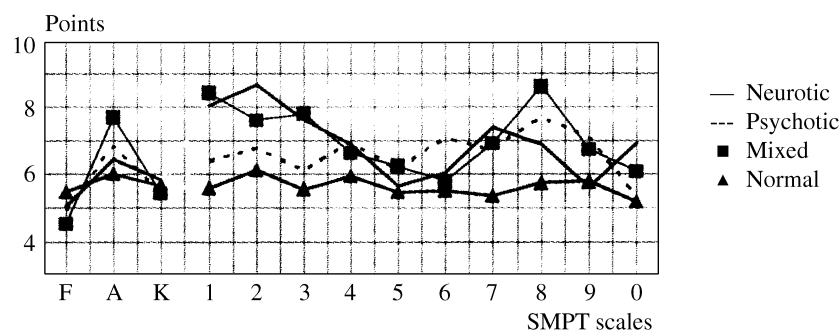


Fig. 1. Mean SMPT profiles in subgroups with different personality maladaptation profiles. Assessment scales: F = falsehoods; A = aggravations and simulations; K = corrections. Basic scales: 1) self-control; 2) pessimism; 3) emotional lability; 4) impulsivity; 5) femininity-masculinity; 6) rigidity; 7) anxiety; 8) individuality; 9) optimism and activity; 0) social introversion.

TABLE 1. Characteristics of Subgroups of Patients with Different Personality Maladaptation Variants, SMPT Method

Measure	Personality maladaptation variant			Normal SMPT profiles (IV)
	Neurotic (I)	Psychotic (II)	Mixed (III)	
Number of patients	13 (38%)	5 (15%)	7 (21%)	9 (26%)
Age, years	26–45	17–42	29–52	16–51
Mean age, years	33.4±6.9	29.8±10.1	41.7±8.5*	33.9±10.8
Duration of illness, years	1–21	3–23	2–30	1–15
Mean duration of illness, years	6.4±5.7	9.8±7.9	17.9±9.8**	6.7±5.5
Age at diagnosis, years	17–38	14–27	14–30	13–40
Mean age at diagnosis, years	27.0±6.5	20.0±4.9	23.9±6.3	27.2±8.3
Severity of illness, EDSS points	0–6.5	2–5.5	1.5–6.5	1.5–6.5
Mean severity of illness, EDSS points	3.3±1.8	4.0±1.4	4.4±1.6	3.2±1.7
Type of course, number of patients:				
remitting	10	3	2	8
progressive	3	2	5	1

Note. Significant difference ($p \leq 0.05$) compared with *subgroup I, **subgroups I and IV.

TABLE 2. Characteristics of Groups with Different Disease Durations

Measure	Disease duration			
	<1 year	1–5 years	6–10 years	>10 years
Number of patients	6	13	9	6
Mean EDSS disease severity	1.42±0.74	3±1.27	4.3±0.92	4.42±1.88*

Note. *Significant differences from groups with disease durations <1 year and 6–10 years ($p < 0.01$).

range. In the group with disease durations of more than 10 years, SMPT scale 8 scores were significantly greater than in the groups with disease durations of less than one year and 1–5 years. Patients of the group with disease durations

of more than 10 years differed ($p < 0.01$) from the groups with disease durations of less than one year and 6–10 years in terms of severity (on the EDSS scale). In other words, increases in disease duration and symptom severity are

TABLE 3. Correlations between SMPT Scales and Relative GMR Levels ($p < 0.05$)

SMPT scale	Right hemisphere			Left hemisphere		
	Structure	<i>r</i>	<i>p-level</i>	Structure	<i>r</i>	<i>p-level</i>
1	NL	0.37	0.0312			
	PCT	0.33	0.0536			
2				MESMTH	−0.38	0.0255
3	FMI	0.34	0.0527	FMI	0.44	0.0086
	NL	0.40	0.0176			
4				NC	0.33	0.0542
5 M	CER	−0.52	0.0466	CER	−0.54	0.0375
	FA	0.60	0.0186	FA	0.54	0.0361
5 F	FIS	0.50	0.0298	GH	−0.52	0.0210
	INS	0.46	0.0501			
6	FII	−0.44	0.0090	FII	−0.54	0.0010
				PS	−0.34	0.0534
7	CER	−0.37	0.0328	CER	−0.37	0.0297
	FA	0.34	0.0521	MESMTH	−0.59	0.0002
	FSI	0.39	0.0217	TI	−0.35	0.0415
8	CER	−0.38	0.0277	CER	−0.37	0.0307
				FII	−0.40	0.0183
				LNG	−0.34	0.0518
				MESMTH	−0.34	0.0526
				TI	−0.35	0.0409
0	FUS	−0.42	0.0127	NC	0.46	0.0068
	GCA	0.44	0.0093			
	LNG	−0.42	0.0125			
	PS	−0.46	0.0111			

Notes. SMPT scales: 1) self-control; 2) pessimism; 3) emotional lability; 4) impulsivity; 5) femininity-masculinity; 6) rigidity; 7) anxiety; 8) individuality; 0) social introversion. Brain structures: CER = cerebellum; FA = precentral gyrus; FII = basal parts of lower frontal gyrus; FIS = areas of the inferior frontal gyrus; FMI = basal parts of intermediate frontal gyrus; FSI = basal parts of the superior frontal gyrus; FUS = fusiform gyrus; GCA = anterior part of cingulate gyrus; GH = parahippocampal gyrus; INS = insular gyrus; LNG = lingual gyrus; MESMTH = geniculate bodies (midbrain and metathalamus); NC = caudate nucleus; NL = lenticular nucleus; PCT = precentral lobule; PS = superior parietal lobule; TI = inferior temporal gyrus. The term *p-level* here and in Table 4 identifies the level of significance.

associated with degradation of social adaptation and personality tension of the neurotic variety, with subsequent development of psychopathology.

The differences between the individual variants of personality maladaptation identified using the SMPT method and the characteristics of the pathogenesis of MS (changes in metabolic processes in the brain) provide grounds for asking whether these two factors are linked.

The authors of the SMPT method note that it is a multifactorial method for studying personality, so a more complex approach to interpreting the data is now widely used [18]. However, each scale reflects a defined set of personality properties providing evidence of adaptive processes. Thus, relationships between individual personality charac-

teristics (reflected as increases in point scores on individual SMPT scales) and the characteristics of metabolic processes were sought by correlation analysis; the results are presented in Table 3, which only shows relationships significant at $p \leq 0.05$.

The data presented in Table 3 provide evidence of a correlation between individual personality characteristics and the level of glucose metabolism in a number of structures, particularly the frontal, temporal, and parietal areas of the cerebral cortex, the limbic system (the cingulate gyrus, the caudate nucleus, the parahippocampal gyrus, etc.), and the cerebellum, i.e., those areas with direct roles in forming the basic characteristics of personality. Correlations were found between relative GMR values and measures on virtu-

TABLE 4. Differences in Local GMR Levels in Subgroups of Patients with Different Personality Maladaptation Profiles ($p < 0.05$)

Brain structure	<i>p</i> -level	Relative GMR level	
Subgroups I and IV			
LCA – hippocampus	0.0178	72.48±6.44	78.95±5.88
LTI – inferior temporal gyrus	0.0300	104.69±5.52	99.88±4.34
RPRC – precuneus	0.0354	122.33±6.22	114.98±8.56
Subgroups II and IV			
LFA – precentral gyrus	0.0388	115.66±5.14	109.84±4.35
LFUS – fusiform gyrus	0.0278	106.89±2.34	103.51±3.14
LTI – inferior temporal gyrus	0.0278	107.60±5.56	99.88±4.34
RFII – basal parts of inferior frontal gyrus	0.0532	97.56±11.07	106.79±5.68
RGH – parahippocampal gyrus	0.0027	81.93±4.06	89.84±2.87
ROM – medial part of occipital lobe	0.0136	122.98±2.35	130.03±6.71
RPCT – precentral lobule	0.0388	116.09±3.94	110.28±5.89
Subgroups III and IV			
LPI – inferior parietal lobule	0.0229	104.92±4.64	111.48±7.53
RPRC – precuneus	0.0229	122.13± 3.54	114.98±8.56
Subgroups I and II			
LNA – amygdala	0.0433	68.40±7.70	59.81±5.02
LPCT – precentral lobule	0.0266	120.04±6.68	108.68±7.37
LPRC – precuneus	0.0090	129.74±5.54	121.76±2.56
LPS – superior parietal lobule	0.0500	99.05±35.96	117.75±8.69
Subgroups I and III			
LCA – hippocampus	0.0293	72.48±6.44	79.52±8.02
LFMM – medial parts of intermediate frontal gyrus	0.0357	119.05±5.85	113.30±4.13
LFMS – lateral parts of intermediate frontal gyrus	0.0004	121.37±4.05	111.55±4.26
LPRC – precuneus	0.0433	129.74±5.54	123.19±6.19
RCA – hippocampus	0.0100	72.78±7.72	81.38±4.77
Subgroups II and III			
LFIS – areas of the inferior frontal gyrus	0.0424	125.41±8.05	115.12±5.78
LFMM – medial parts of intermediate frontal gyrus	0.0118	124.94±8.93	113.30±4.13
LNA – amygdala	0.0185	59.81±5.02	72.53±6.89
LPI – inferior parietal lobule	0.0284	115.15±6.19	104.92±4.64
LPS – superior parietal lobule	0.0176	117.75±8.69	103.00±7.70
RGH – parahippocampal gyrus	0.0284	81.93±4.06	89.93±4.95

Notes. Initial letters in structure designations: L = left, R = right hemisphere. GMR values are shown as percentages in relation to the mean level of brain glucose metabolism.

ally all SMPT scales, with the exception of scale 9. Negative correlations of scales 7, 8, and 5 (in males) with cerebellar activity were seen bilaterally, demonstrating that this structure has an important role in maintaining anxiety, mental tension, and impairments of interpersonal and sexual adaptation.

The role of brain glucose metabolic processes in producing personality maladaptation variants were studied by

comparing subgroups with different variants of SMPT profiles in terms of relative GMR assessments. Significant differences are shown in Table 4.

Subgroup I, with the neurotic variant of personality maladaptation, differed from the subgroup with the normal SMPT profile (subgroup IV) in relation to decreases in GMR in structures of the limbic system of the left hemisphere (hippocampus) and increases in areas of the left tem-

poral cortex and the right parietal cortex. Subgroup II, with the psychotic variant of maladaptation, had the largest number of differences from the subgroup with the normal profile (subgroup IV) and was characterized by relative increases in GMR in areas of the parietal and temporal cortex of the left hemisphere and decreases in structures of the limbic system (lower frontal and parahippocampal gyrus) on the right. The subgroup with the mixed profile (subgroup III), unlike the subgroup with the normal profile (subgroup IV), was characterized by relative decreases in GMR in areas of the parietal cortex on both sides.

In addition, there was a difference in measures of GMR between subgroups with different variants of personality maladaptation. Subgroups with the neurotic and psychotic variants differed from the subgroup with the normal SMPT profile in terms of relative GMR assessments in same brain structures – the parietal and temporal areas of the cortex and structures of the limbic system; there was also a coincidence of the nature of the differences (decreases in GMR in limbic structures and increases in the parietal and temporal areas of the cortex). However, interhemispheric lateralization was seen in the subgroups: the neurotic variant of personality maladaptation was associated with differences in GMR in the parietal area of the right hemisphere and limbic structures of the left hemisphere, while the psychotic variant was associated with the opposite pattern – differences were seen in the parietal area on the left and limbic structures on the right. Increases in GMR in structures of the temporal zone of the left hemisphere were common to these two subgroups. Subgroup III, with the mixed variant of personality maladaptation, showed the greatest difference from subgroups I and II in terms of relative decreases in GMR in areas of the frontal and parietal cortex on the left and increases in structures of the limbic system (hippocampus, parahippocampal gyrus, amygdala) bilaterally. It should be emphasized that these subgroups differed in terms of GMR measures mainly in structures of the left hemisphere.

In other words, subgroups with different SMPT profiles differed in terms of measures of GMR in a number of structures of the frontal, temporal, and parietal areas, as well as structures of the limbic system. However, similar structures and brain areas are involved in producing different variants of personality maladaptation; each variant was characterized by its own means of functioning, with increases or decreases in GMR, as well as interhemisphere lateralization.

DISCUSSION

In accord with Sobchik's concept, which guided our interpretation of the SMPT results, personality maladaptation variants are based on individual psychological personality features determined by genetic predisposition, consti-

tutional characteristics, the type of higher nervous activity, and temperament [18]. Our results show that the subgroups with the neurotic and psychotic variants of personality maladaptation were characterized by relative decreases in GMR in structures of the limbic system and increases in areas of the parietal-temporal cortex; the subgroups with the mixed variant showed relative decreases in GMR in the frontal and parietal cortex, with relative increases in structures of the limbic system. It can thus be suggested that one of the neurophysiological mechanisms underlying the formation of personality maladaptation variants may be variation in GMR in the brain, as this characterizes the level of activation of different structures and allows assessment of the nature of their involvement in supporting mental processes. It should be noted that PET data only provide evidence relating to the level of metabolic activity of brain structures without providing any information on the processes occurring within them – inhibition or excitation – because both of these processes require additional energy expenditure; the method allows detection of functionally active structures.

Many neuropsychological and neurophysiological studies have demonstrated that any mental process is a complex functional system and involves the participation of intricate complexes of simultaneously functioning brain systems, each of which makes its own contribution to organizing the functional system [1, 2, 9]. Thus, our results show that support of the different variants of personality maladaptation stably involves defined structures which in all probability, according to Bekhtereva's concept [4], constitute a structural-functional system with components with different degrees of stability. Luriya [10] distinguished three functional blocks including defined parts of the brain (regulation of tone and consciousness, information processing, and control of mental activity), each of which has to be involved to produce any kind of mental activity. In this sense, our results are consistent with published data.

Our results provide evidence that there is a correlation between personality maladaptation variants and functional activity in areas of cortical and subcortical structures in both hemispheres in patients with MS. The frontal, temporal, and parietal areas of the cortex play important roles in these relationships, as do structures of the limbic-reticular complex (amygdala, hippocampus, cingulate gyrus, caudate nucleus). These brain structures and their interactions and functional characteristics probably also form those stable pathophysiological systems [4] which underlie maladaptive personality patterns.

It is known from the neuropsychological literature that lesions to the anterior parts of the brain, which have numerous connections with the hypothalamus, limbic system, and reticular formation, can be accompanied by emotional-personality pathology [8], particularly the so-called "frontal syndrome." The frontal lobes have been described as having a monitoring and controlling function in relation to mental activity and emotional-personality reactions [8]. A relation-

ship between the temporal lobes of the cerebral cortex and formations of the limbic-reticular system has also been demonstrated [12]. The parietal areas of the cortex are of prime significance in organizing the "body image" system and in perception of self ("I"), i.e., in maintaining the integrity of personality structure. The limbic system plays the leading role in supporting the emotions. Thus, a relationship between the hippocampus and the amygdala on the one hand, and the mechanisms of emotional memory on the other, has been described [19, 20], and these structures have been shown to play a role in generating emotional behavior [15]. Madorskii's studies [11] in patients with lesions of the right and left hippocampi identified defects in the form of emotional flattening or emotional tension. In our case, bilateral increases in GMR in the hippocampus, characteristic of patients with the mixed variant of personality maladaptation, may reflect these mechanisms. In addition, the amygdala is associated with adaptation and motivation processes and is also involved in protective mechanisms for the mind and body in general [13]. The part of the limbic system including the cingulate gyrus controls social programs, supporting functioning in the social context [16]. The caudate nucleus is the most important component of the system of intercenter regulation and is responsible for generating mental states. This activity, which involves inhibitory influences, correlates with the processes of suppression of negative emotions and avoidance of emotional stress [3].

The cerebral organization of emotional-personality processes shows interhemisphere asymmetry. Our data showing the predominant role of the left hemisphere in mediating the different variants of personality maladaptation support the principle of the lateral specialization of the cerebral organization of higher mental functions [3]. The measures analyzed here reflect the conscious and unconscious levels of personality. The SMPT questionnaire allows detection of conscious reflections of the leading emotional-activatory pattern in terms of personality. In this sense, our data are consistent with published data on the predominant role of the left hemisphere in supporting voluntary (conscious) control of mental functions [14].

Thus, our data demonstrate the important role of the activity of metabolic processes, particularly in the frontal and temporal-parietal areas of the cortex and structures of the limbic system of both hemispheres of the brain, in supporting the different personality maladaptation variants. Interhemisphere lateralization of the metabolic activity of brain structures is important in this framework. Cerebral systems of the left hemisphere were found to play the predominant role in its origination.

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